

# *Primality-testing Mersenne numbers*

Article

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83T-10-82 S M HOLMES, D J HUNT, T W LAKE, P J MARRON, S F REDDAWAY, N WESTBURY and G M<sup>C</sup> HAWORTH:  
ICL, Reading, RG1 8PN, UK. Primality-testing Mersenne Numbers. Preliminary Report.

$M_p = 2^p - 1$ , index  $p$  prime, is a Mersenne Number. Let  $S_1 = 4$  and let  $S_{n+1} = S_n^2 - 2 \pmod{M_p}$ . The Lucas-Lehmer primality test (LLT) is " $M_p$  prime  $\Leftrightarrow$  residue  $S_{p-1} = 0$ ". We have exercised the LLT on an index-set  $P$  using Fast Fermat-number-transform multiplication. Codes A and B ran on an ICL DAP, an SIMD parallel processor having 4096 elementary processing elements. Code C is under test.

$P$  is a comprehensive set of primes for two reasons. First, the code for the relatively complex transform algorithm deserves the fullest testing. Secondly, the LLT is non-constructive and its history includes some incorrect residues which were temporarily thought to 'prove' their  $M_p$  composite. We believe an 'LLT proof' must include two independent residue computations. Thus, while we did not include almost all  $p < 38220$  like Nelson,  $P$  otherwise contains all  $p$  for which we knew or presumed the LLT had been applied.  $P$  also contains all  $p < 62982$  for which we knew of no  $M_p$ -factor.

Our codes checked the squaring mod-7 and were run twice over their respective ranges. Code A for  $p < 31488$  tested  $M_{31487}$  in 142 seconds; Code B for  $p < 62976$  tested  $M_{62929}$  in 562 seconds.

For some 2828  $p$  less than the previous search-limit of 50024 we confirmed and filed a definitive set of residues. We thus validated the results, as sometimes corrected, of Hurwitz/Selfridge, Kravitz/Berg, Gillies, Tuckerman, Nickel/Noll and Nelson/Slowinski. For the range  $50024 < p < 62982$ , our 475 new residues are all non-zero and so reveal no new prime  $M_p$ : we invite their confirmation.

(Received October 22, 1982) (Introduced by R. P. Brent)